Product Specification
AU OPTRONICS CORPORATION

(✓) **Preliminary Specifications**

( ) **Final Specifications**

Module	15.6"HD 16:9 Color TFT-LCD with LED Backlight design
Model Name	B156XTN02.1 (H/W:0A)
Note (🔔)	*LED Backlight with driving circuit design*

Customer	Date

Checked & Approved by	Date

Note: This Specification is subject to change without notice.

Approved by	Date
Buffy Chen	06/27/2011

Prepared by	Date
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NBBU Marketing Division
AU Optronics corporation

Contents

Record of Revision

Version and Date	Page	Old description	New Description	Remark
0.1 2011/06/27	All	First Edition for Customer		

1. Handling Precautions

1) Since front polarizer is easily damaged, pay attention not to scratch it.

2) Be sure to turn off power supply when inserting or disconnecting from input connector.

3) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.

4) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.

5) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface.

6) Since CMOS LSI is used in this module, take care of static electricity and insure human earth when handling.

7) Do not open nor modify the Module Assembly.

8) Do not press the reflector sheet at the back of the module to any directions.

9) At the insertion or removal of the Signal Interface Connector, be sure not to rotate nor tilt the Interface Connector of the TFT Module.

11) After installation of the TFT Module into an enclosure (Notebook PC Bezel, for example), do not twist nor bend the TFT Module even momentary. At designing the enclosure, it should be taken into consideration that no bending/twisting forces are applied to the TFT Module from outside. Otherwise the TFT Module may be damaged.

12) Small amount of materials having no flammability grade is used in the LCD module. The LCD module should be supplied by power complied with requirements of Limited Power Source (IEC60950 or UL1950), or be applied exemption.

13) Disconnecting power supply before handling LCD modules, it can prevent electric shock, DO NOT TOUCH the electrode parts, cables, connectors and LED circuit part of TFT module that a LED light bar build in as a light source of back light unit. It can prevent electronic breakdown.

2. General Description

B156XTN02.1 is a Color Active Matrix Liquid Crystal Display composed of a TFT LCD panel, a driver circuit, and LED backlight system. The screen format is intended to support the 16:9 HD, 1366(H) x768(V) screen and 262k colors (RGB 6-bits data driver) with LED backlight driving circuit. All input signals are LVDS interface compatible.

B156XTN02.1 is designed for a display unit of notebook style personal computer and industrial machine.

2.1 General Specification

The following items are characteristics summary on the table at 25 ℃ condition:

| Items	Unit	Specifications			
Screen Diagonal	[mm]	394.91			
Active Area	[mm]	344.23 X193.54			
Pixels H x V		1366x3(RGB) x 768			
Pixel Pitch	[mm]	0.252X0.252			
Pixel Format		R.G.B. Vertical Stripe			
Display Mode		Normally White			
White Luminance (I_{LED}=25mA) **(Note: ILED is LED current)**	[cd/m^2]	220 typ. (5 points average) 187 min. (5 points average)			
Luminance Uniformity		1.25 max. (5 points)			
Contrast Ratio		400 typ			
Response Time	[ms]	16 Max			
Nominal Input Voltage VDD	[Volt]	+3.3 typ.			
Power Consumption	[Watt]	5.0 max. (Include Logic and Blu power)			
Weight	[Grams]	450 max.			
Physical Size **Include bracket**	[mm]		Min.	Typ.	Max.
		Length	-	359.3	359.8
		Width	-	209.5	210
		Thickne	-	-	5.5
Electrical Interface		1 channel LVDS			
Glass Thickness	[mm]	0.5			
Surface Treatment		Anti Glare, Hardness 3H,			
Support Color		262K colors (RGB 6-bit)			

Temperature Range
  Operating
  Storage (Non-Operating)
	[ºC]
	[ºC]
		0 to +50
		-20 to +60			

RoHS Compliance		RoHS Compliance			

2.2 Optical Characteristics

The optical characteristics are measured under stable conditions at 25℃ (Room Temperature) :

Item	Symbol		Conditions	Min.	Typ.	Max.	Unit	Note
White Luminance I$_{LED}$=25mA			5 points average	187	220	-	cd/m²	1, 4, 5.
Viewing Angle	θ$_R$ θ$_L$		Horizontal (Right) CR = 10 (Left)	40 40	45 45	- -	degree	4, 9
	ψ$_H$ ψ$_L$		Vertical (Upper) CR = 10 (Lower)	10 30	15 35	- -		
Luminance Uniformity	δ$_{5P}$		5 Points	-	-	1.25		1, 3, 4
Luminance Uniformity	δ$_{13P}$		13 Points	-	-	1.50		2, 3, 4
Contrast Ratio	CR			-	400	-		4, 6
Cross talk	%					4		4, 7
Response Time	T$_r$		Rising	-	6	-	msec	4, 8
	T$_f$		Falling	-	2	-		
	T$_{RT}$		Rising + Falling	-	8	16		
Color / Chromaticity Coodinates	Red	Rx	CIE 1931	TBD	TBD	TBD		4
		Ry		TBD	TBD	TBD		
	Green	Gx		TBD	TBD	TBD		
		Gy		TBD	TBD	TBD		
	Blue	Bx		TBD	TBD	TBD		
		By		TBD	TBD	TBD		
	White	Wx		0.283	0.313	0.343		
		Wy		0.299	0.329	0.359		
NTSC	%			-	60	-		

Note 1: 5 points position (Ref: Active area)
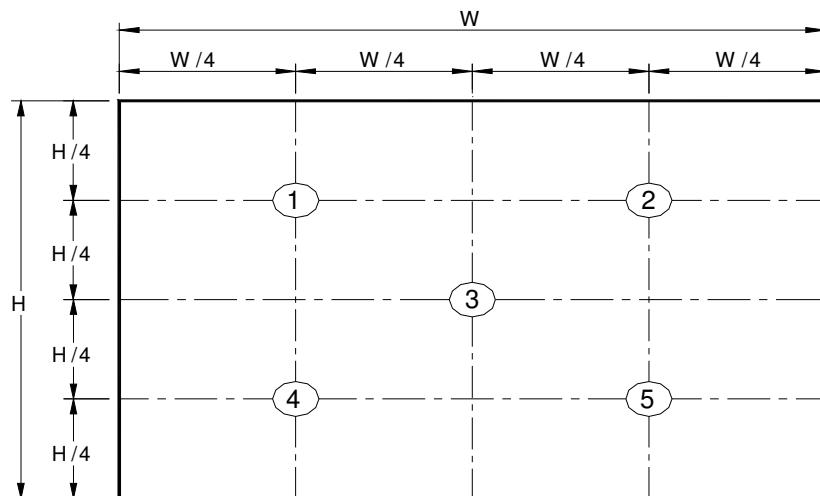
Note 2: 13 points position (Ref: Active area)
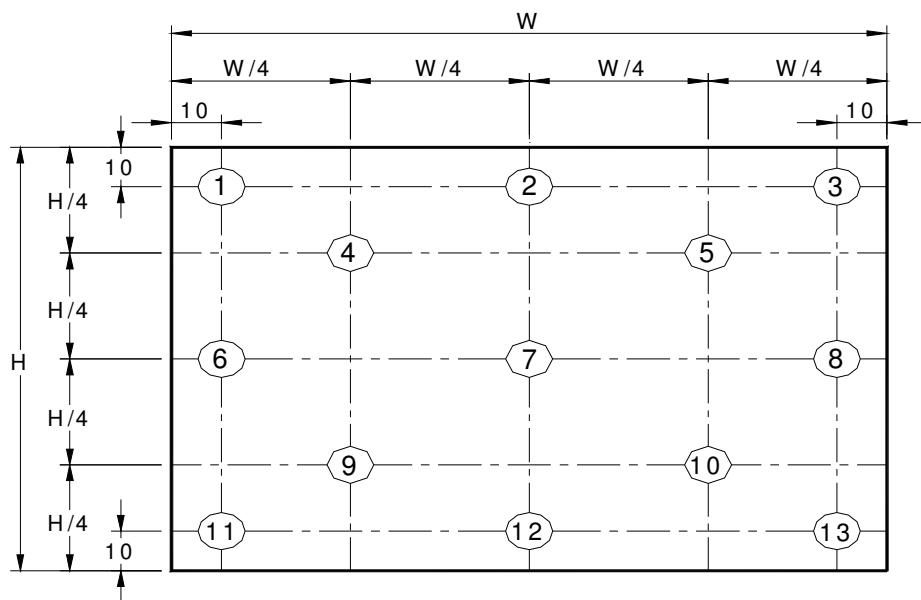
Note 3: The luminance uniformity of 5 or13 points is defined by dividing the maximum luminance values by the minimum test point luminance

$$\delta_{W5} \quad = \quad \frac{\text{Maximum Brightness of five points}}{\text{Minimum Brightness of five points}}$$

$$\delta_{W13} \quad = \quad \frac{\text{Maximum Brightness of thirteen points}}{\text{Minimum Brightness of thirteen points}}$$

Note 4: Measurement method

The LCD module should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after

lighting Backlight for 30 minutes in a stable, windless and dark room, and it should be measured in the center of screen.
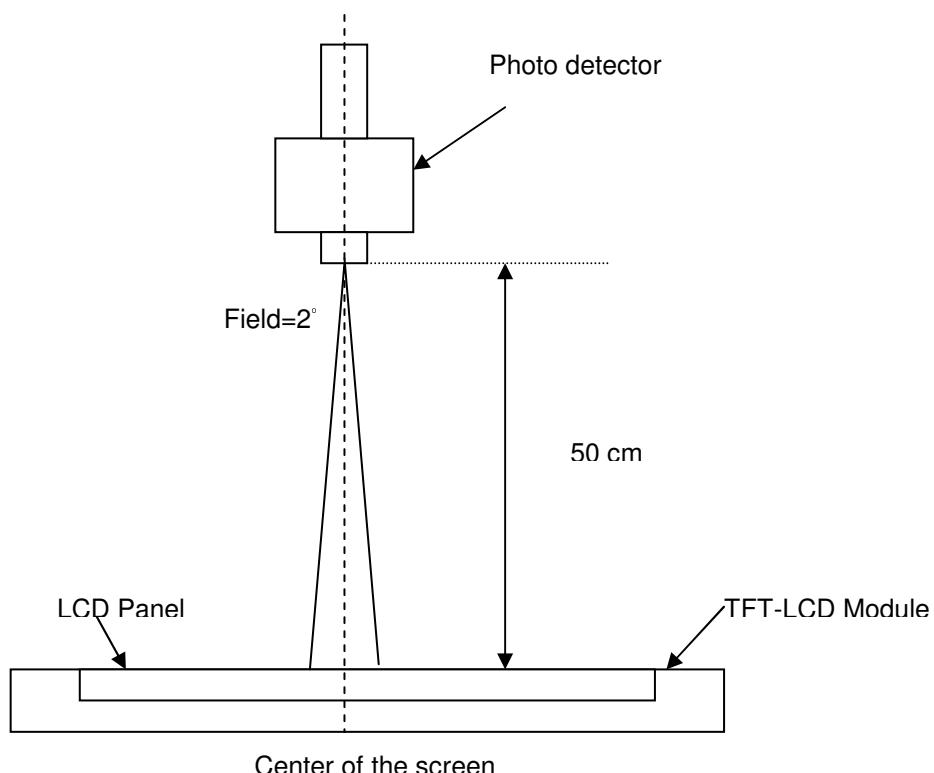
Note 5： Definition of Average Luminance of White (Y_L):

Measure the luminance of gray level 63 at 5 points，Y_L = [L (1)+ L (2)+ L (3)+ L (4)+ L (5)] / 5

L (x) is corresponding to the luminance of the point X at Figure in Note (1).

Note 6： Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio (CR)}= \frac{\text{Brightness on the "White" state}}{\text{Brightness on the "Black" state}}$$

Note 7： Definition of Cross Talk (CT)

CT = | Y_B – Y_A | / Y_A × 100 (%)

Where

Y_A = Luminance of measured location without gray level 0 pattern (cd/m2)

Y_B = Luminance of measured location with gray level 0 pattern (cd/m2)
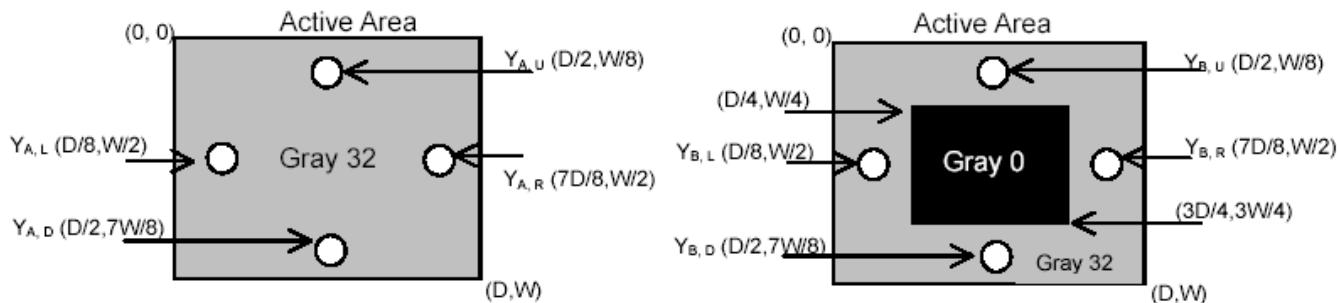
Note 8: Definition of response time:

The output signals of BM-7 or equivalent are measured when the input signals are changed from "Black" to "White" (falling time) and from "White" to "Black" (rising time), respectively. The response time interval between the 10% and 90% of amplitudes. Refer to figure as below.
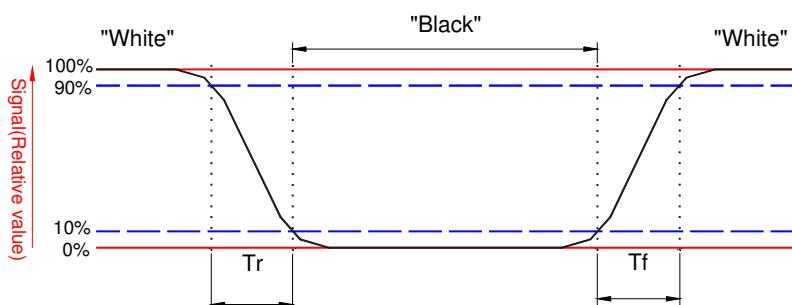
Note 9. Definition of viewing angle

Viewing angle is the measurement of contrast ratio ≥ 10, at the screen center, over a 180° horizontal and 180° vertical range (off-normal viewing angles). The 180° viewing angle range is broken down as follows; 90° (θ) horizontal left and right and 90° (Φ) vertical, high (up) and low (down). The measurement direction is typically perpendicular to the display surface with the screen rotated about its center to develop the desired measurement viewing angle.
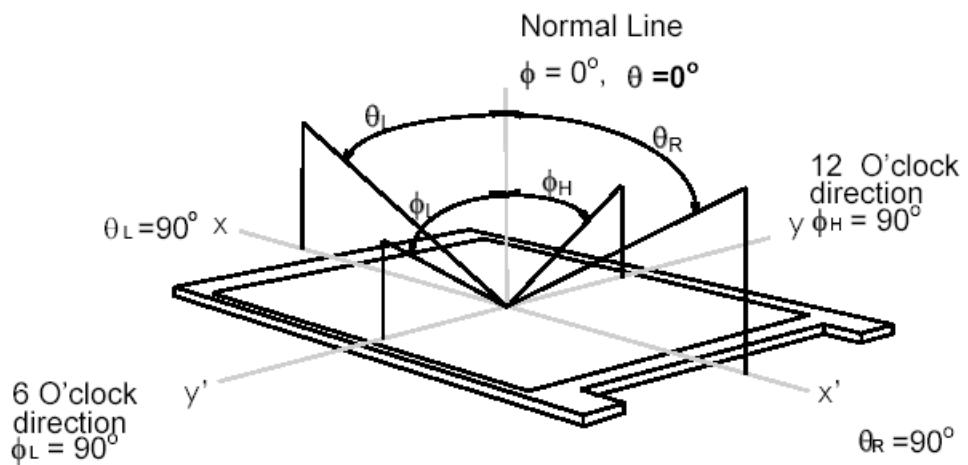
3. Functional Block Diagram

The following diagram shows the functional block of the 15.6 inches wide Color TFT/LCD 40 Pin one channel Module
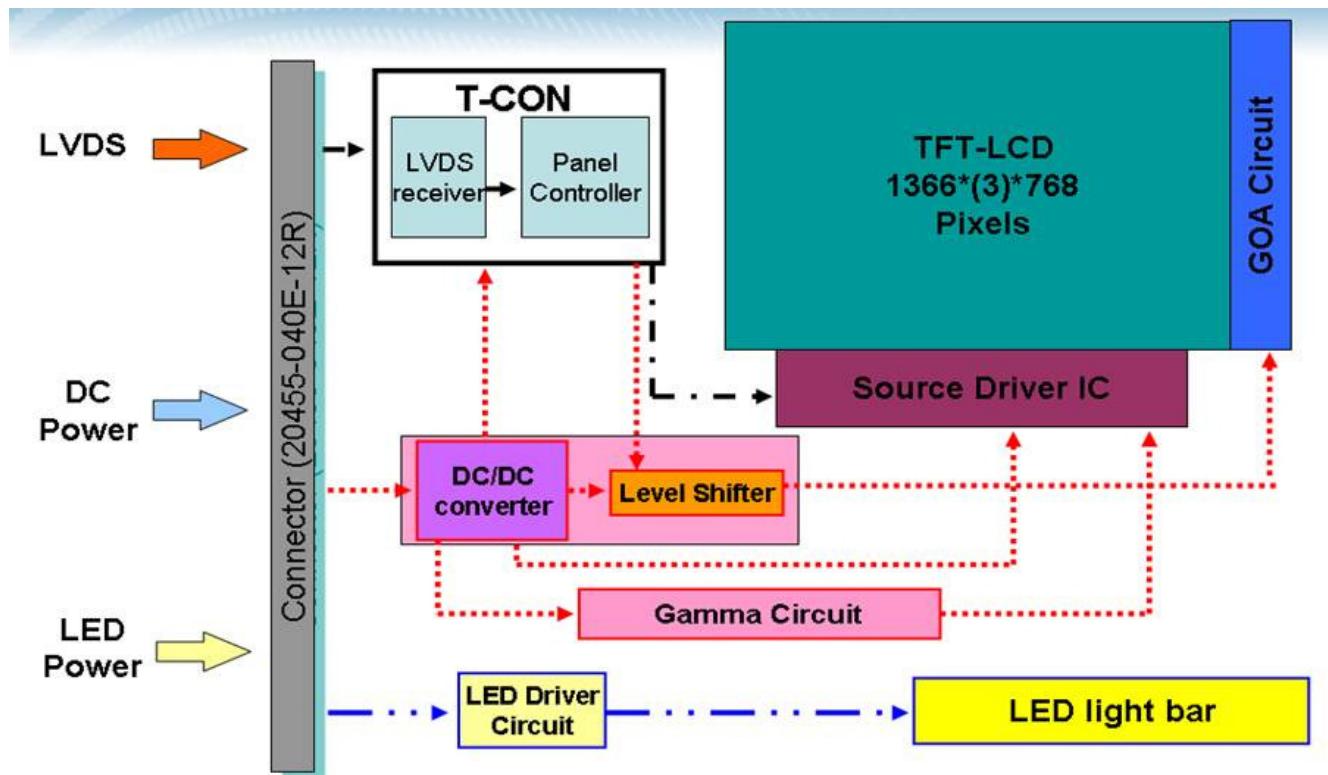
4. Absolute Maximum Ratings

An absolute maximum rating of the module is as following:

4.1 Absolute Ratings of TFT LCD Module

| Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive	Vin	-0.3	+4.0	[Volt]	Note 1,2

4.2 Absolute Ratings of Environment

Item	Symbol	Min	Max	Unit	Conditions
Operating	TOP	0	+50	[ºC]	Note 4
Operation Humidity	HOP	5	95	[%RH]	Note 4
Storage Temperature	TST	-20	+60	[ºC]	Note 4
Storage Humidity	HST	5	95	[%RH]	Note 4

Note 1: At Ta (25℃)

Note 2: Permanent damage to the device may occur if exceed maximum values

Note 3: LED specification refer to section 5.2

Note 4: For quality performance, please refer to AUO IIS (Incoming Inspection Standard).
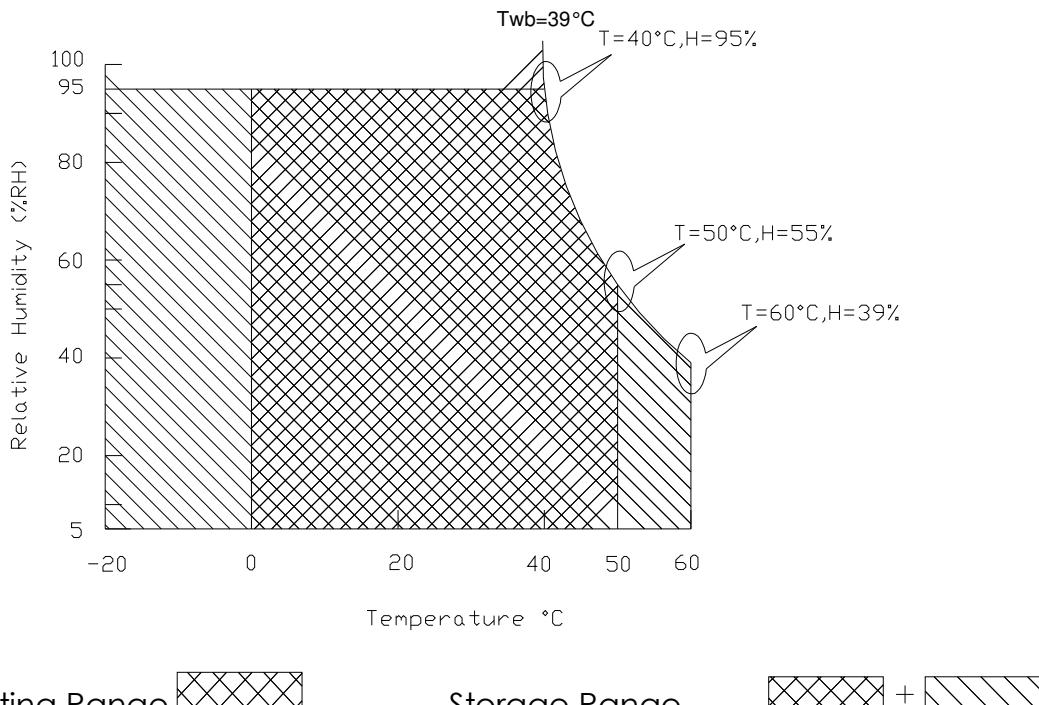
Operating Range   Storage Range

5. Electrical Characteristics

5.1 TFT LCD Module

5.1.1 Power Specification

Input power specifications are as follows;

The power specification are measured under 25℃ and frame frenquency under 60Hz

Symble	Parameter	Min	Typ	Max	Units	Note
VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[Volt]	
PDD	VDD Power	-	-	1.3	[Watt]	Note 1
IDD	IDD Current	-	250	400	[mA]	Note 1
IRush	Inrush Current	-	-	1500	[mA]	Note 2
VDDrp	Allowable Logic/LCD Drive Ripple Voltage	-	-	100	[mV] p-p	

Note 1 : Maximum Measurement Condition : Black Pattern at 3.3V driving voltage. ($P_{max}=V_{3.3}$ x I_{black})

Note 2 : Measure Condition
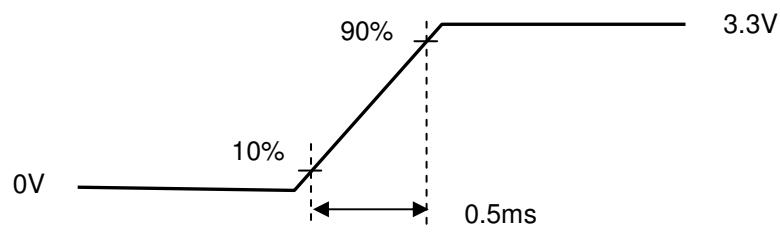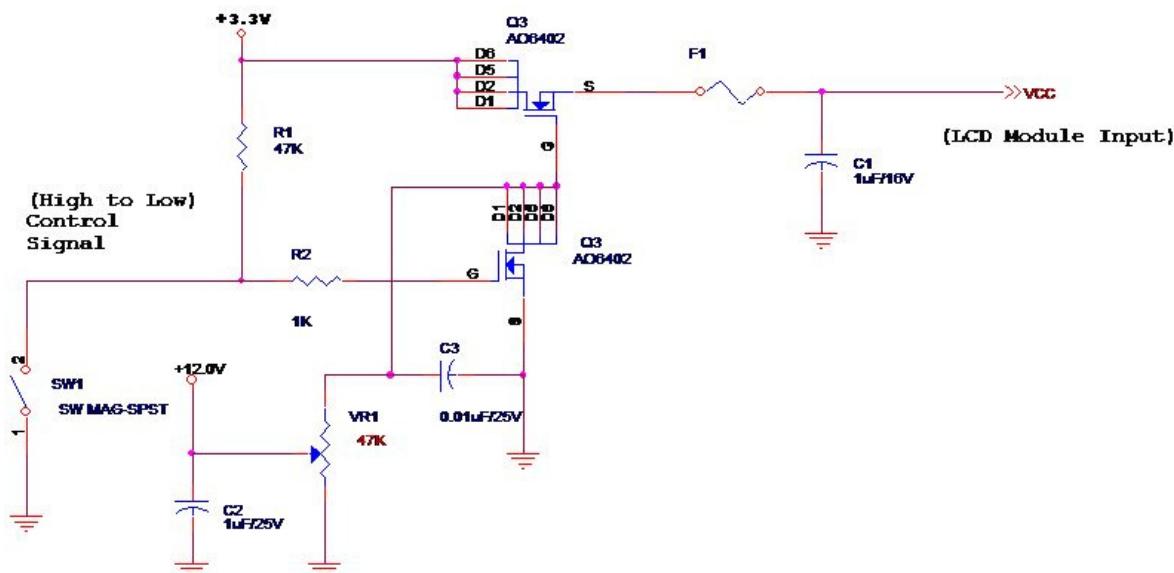

Vin rising time

5.1.2 Signal Electrical Characteristics

Input signals shall be low or High-impedance state when VDD is off.

Signal electrical characteristics are as follows;

Parameter	Condition	Min	Max	Unit
V_{TH}	Differential Input High Threshold (Vcm=+1.2V)		100	[mV]
V_{TL}	Differential Input Low Threshold (Vcm=+1.2V)	-100	-	[mV]
$|V_{ID}|$	Differential Input Voltage	100	600	[mV]
V_{CM}	Differential Input Common Mode Voltage	1.125	1.375	[V]

Note: LVDS Signal Waveform
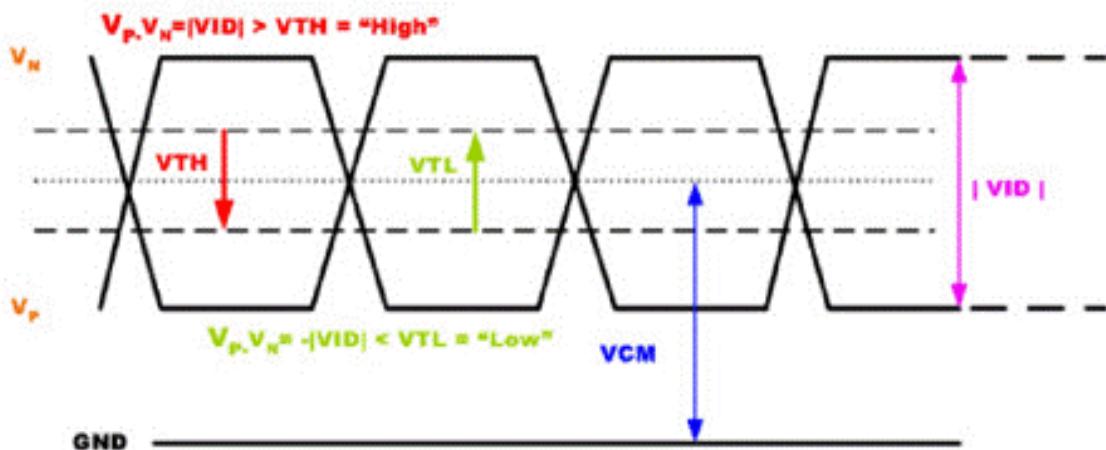
5.2 Backlight Unit

5.2.1 LED characteristics

Parameter	Symbol	Min	Typ	Max	Units	Condition
Backlight Power Consumption	PLED	-	3.05	3.7	[Watt]	(Ta=25℃), Note 1 Vin =12V
LED Life-Time	N/A	12,000	-	-	Hour	(Ta=25℃), Note 2 I_F=20 mA

Note 1: Calculator value for reference P_{LED} = V_F (Normal Distribution) * I_F (Normal Distribution) / Efficiency

Note 2: The LED life-time define as the estimated time to 50% degradation of initial luminous.

5.2.2 Backlight input signal characteristics

| Parameter	Symbol	Min	Typ	Max	Units	Remark
LED Power Supply	VLED	6.0	12.0	21.0	[Volt]	
LED Enable Input High Level	VLED_EN	2.5	-	5.5	[Volt]	
LED Enable Input Low Level		-	-	0.8	[Volt]	
PWM Logic Input High Level	VPWM_EN	2.5	-	5.5	[Volt]	
PWM Logic Input Low Level		-	-	0.8	[Volt]	Define as Connector Interface (Ta=25℃)
PWM Input Frequency	FPWM	100	-	20K	Hz	
PWM Duty Ratio	Duty	5	--	100	%	

6. Signal Interface Characteristic

6.1 Pixel Format Image

Following figure shows the relationship of the input signals and LCD pixel format.
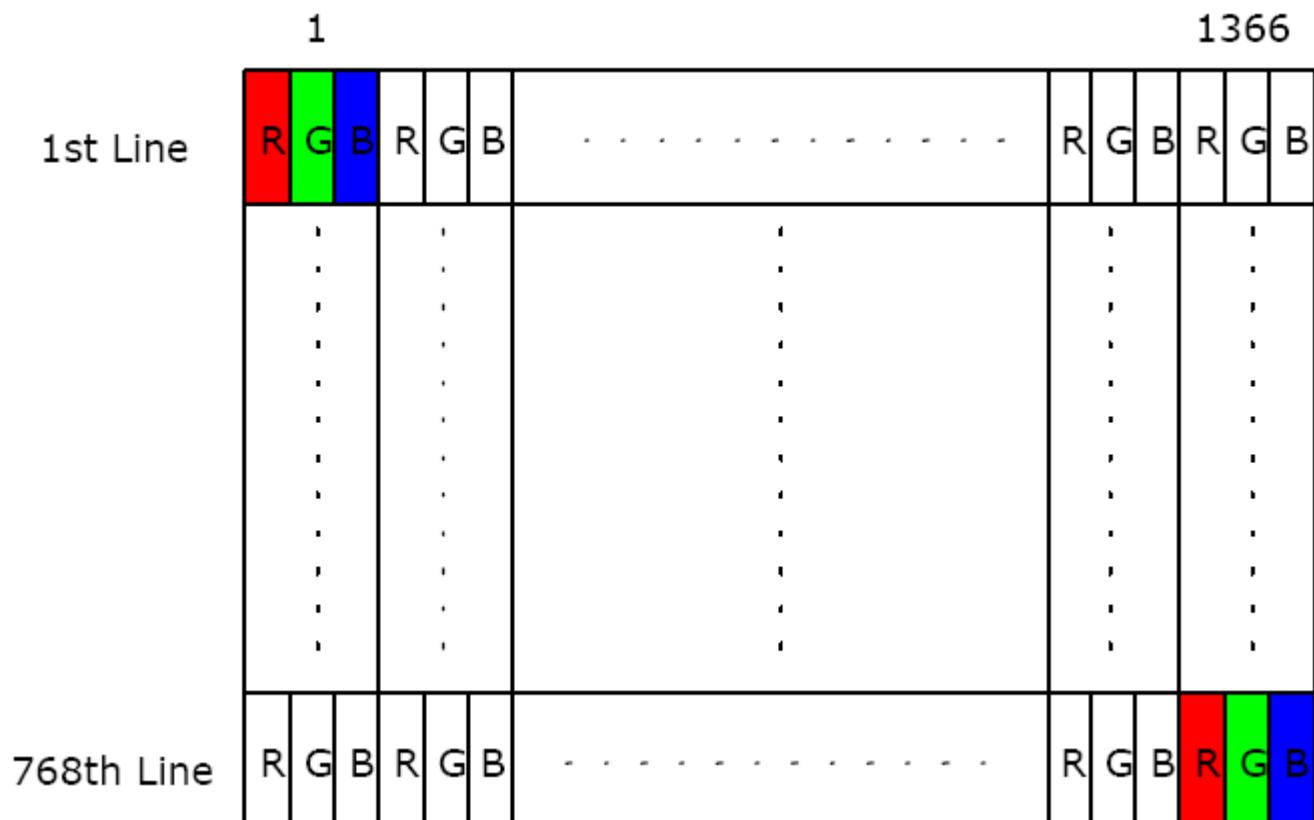
6.2 The Input Data Format
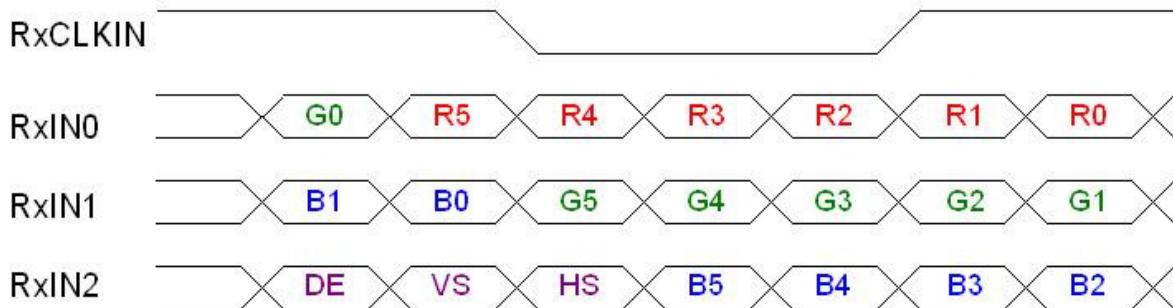
Signal Name	Description	
R5 R4 R3 R2 R1 R0	Red Data 5 (MSB) Red Data 4 Red Data 3 Red Data 2 Red Data 1 Red Data 0 (LSB) Red-pixel Data	Red-pixel Data Each red pixel's brightness data consists of these 6 bits pixel data.
G5 G4 G3 G2 G1 G0	Green Data 5 (MSB) Green Data 4 Green Data 3 Green Data 2 Green Data 1 Green Data 0 (LSB) Green-pixel Data	Green-pixel Data Each green pixel's brightness data consists of these 6 bits pixel data.
B5 B4 B3 B2 B1 B0	Blue Data 5 (MSB) Blue Data 4 Blue Data 3 Blue Data 2 Blue Data 1 Blue Data 0 (LSB) Blue-pixel Data	Blue-pixel Data Each blue pixel's brightness data consists of these 6 bits pixel data.
RxCLKIN	Data Clock	The signal is used to strobe the pixel data and DE signals. All pixel data shall be valid at the falling edge when the DE signal is high.
DE	Display Timing	This signal is strobed at the falling edge of RxCLKIN. When the signal is high, the pixel data shall be valid to be displayed.
VS	Vertical Sync	The signal is synchronized to RxCLKIN .
HS	Horizontal Sync	The signal is synchronized to RxCLKIN .

Note: Output signals from any system shall be low or High-impedance state when VDD is off.

6.3 Integration Interface Requirement

6.3.1 Connector Description

Physical interface is described as for the connector on module.

These connectors are capable of accommodating the following signals and will be following components.

Connector Name / Designation	For Signal Connector
Manufacturer	IPEX or compatible
Type / Part Number	IPEX 20455-040E-12R
Mating Housing/Part Number	IPEX 20353-040T-11

6.3.2 Pin Assignment

LVDS is a differential signal technology for LCD interface and high speed data transfer device.

PIN#	Signal Name	Description
1	NC	Connect to pin34
2	VDD	Power Supply +3.3V (typical)
3	VDD	Power Supply +3.3V (typical)
4	V_EDID	DDC +3.3V Power
5	AGING	Aging
6	EDID_ CLK	EDID_Clock
7	EDID_DATA	EDID_Data
8	RIN0-	-LVDS Differential Data INPUT (R0-R5,G0)
9	RIN0+	+LVDS Differential Data INPUT (R0-R5,G0)
10	GND	Ground
11	RIN1-	-LVDS Differential Data INPUT (G1-G5,B0-B1)
12	RIN1+	+LVDS Differential Data INPUT (G1-G5,B0-B1)
13	GND	Ground
14	RIN2-	-LVDS Differential Data INPUT (B2-B5,HS,VS,DE)
15	RIN2+	+LVDS Differential Data INPUT (B2-B5,HS,VS,DE)
16	GND	Ground
17	ClKIN-	-LVDS Differential Clock INPUT
18	ClKIN+	-LVDS Differential Clock INPUT
19	CM_EN	CM_EN (Color Matrix)
20	NC	No connection
21	NC	No connection

22	GND	Ground
23	NC	No connection
24	NC	No connection
25	GND	Ground
26	NC	No connection
27	NC	No connection
28	GND	Ground
29	NC	No connection
30	NC	No connection
31	VLED_GND	LED Ground
32	VLED_GND	LED Ground
33	VLED_GND	LED Ground
34	NC	Connect to pin1
35	BL_PWM	System PWM Signal input (+3.3V input)
36	BL_EN	LED enable pin (+3.3V input)
37	DCR_EN	DCR_EN
38	VLED	LED Power Supply 6-21V
39	VLED	LED Power Supply 6-21V
40	VLED	LED Power Supply 6-21V
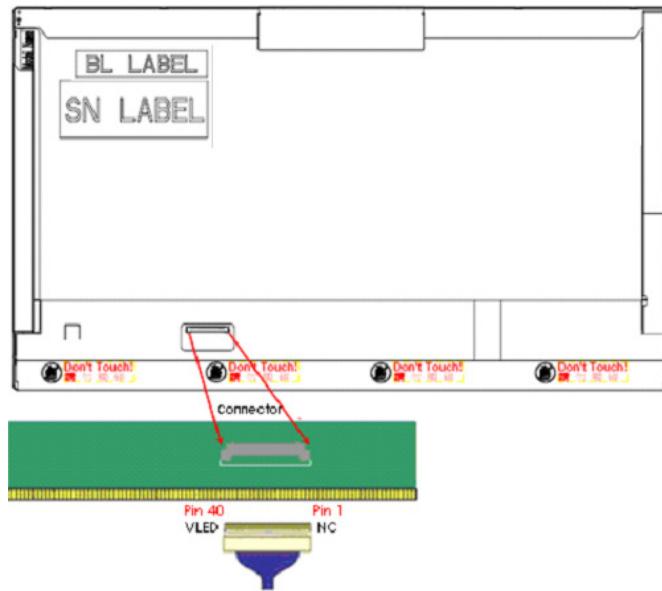
Note1: Input signals shall be low or High-impedance state when VDD is off.

6.4 Interface Timing

6.4.1 Timing Characteristics

Basically, interface timings should match the 1366x768 /60Hz manufacturing guide line timing.

Parameter		Symbol	Min.	Typ.	Max.	Unit
Frame Rate		-	50	60	TBD	Hz
Clock frequency		1/ T_{Clock}	65	69.3	72	MHz
Vertical Section	Period	T_V	776	808	1023	T_{Line}
	Active	T_{VD}		768		
	Blanking	T_{VB}	8	40	255	
Horizontal Section	Period	T_H	1396	1606	2047	T_{Clock}
	Active	T_{HD}		1366		
	Blanking	T_{HB}	30	240	681	

Note : DE mode only

6.4.2 Timing diagram
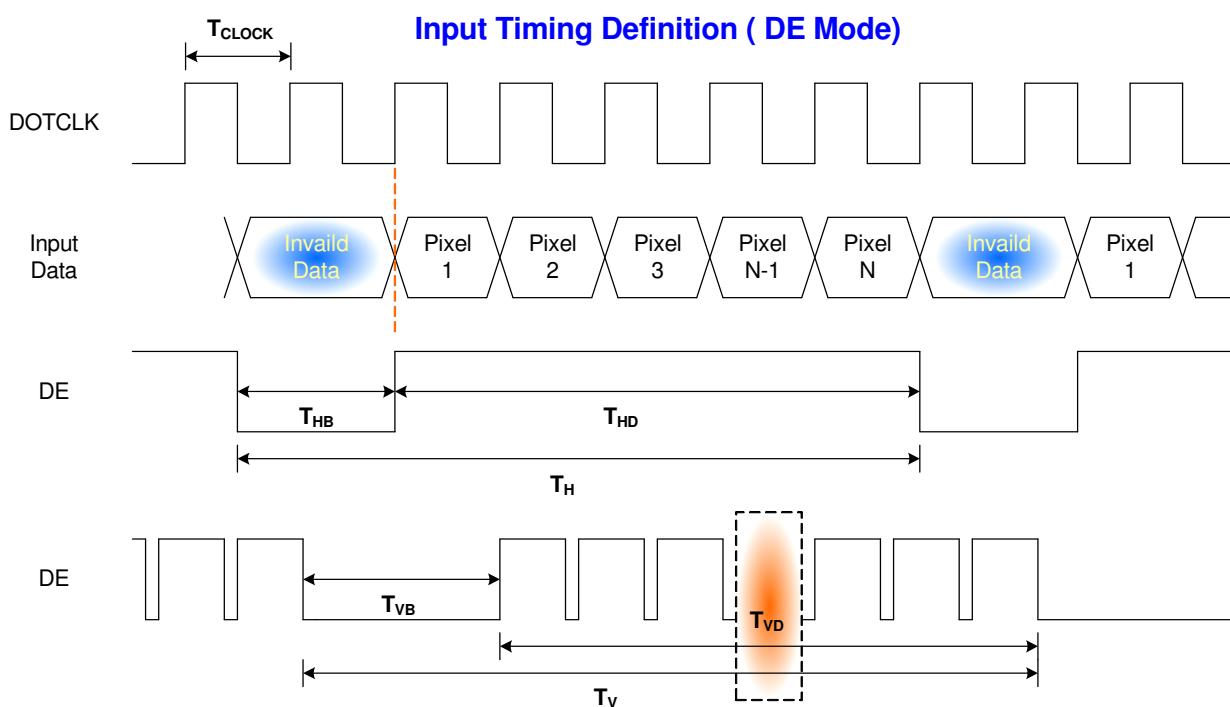
6.5 Power ON/OFF Sequence

Power on/off sequence is as follows. Interface signals and LED on/off sequence are also shown in the chart. Signals from any system shall be Hi-Z state or low level when VDD is off
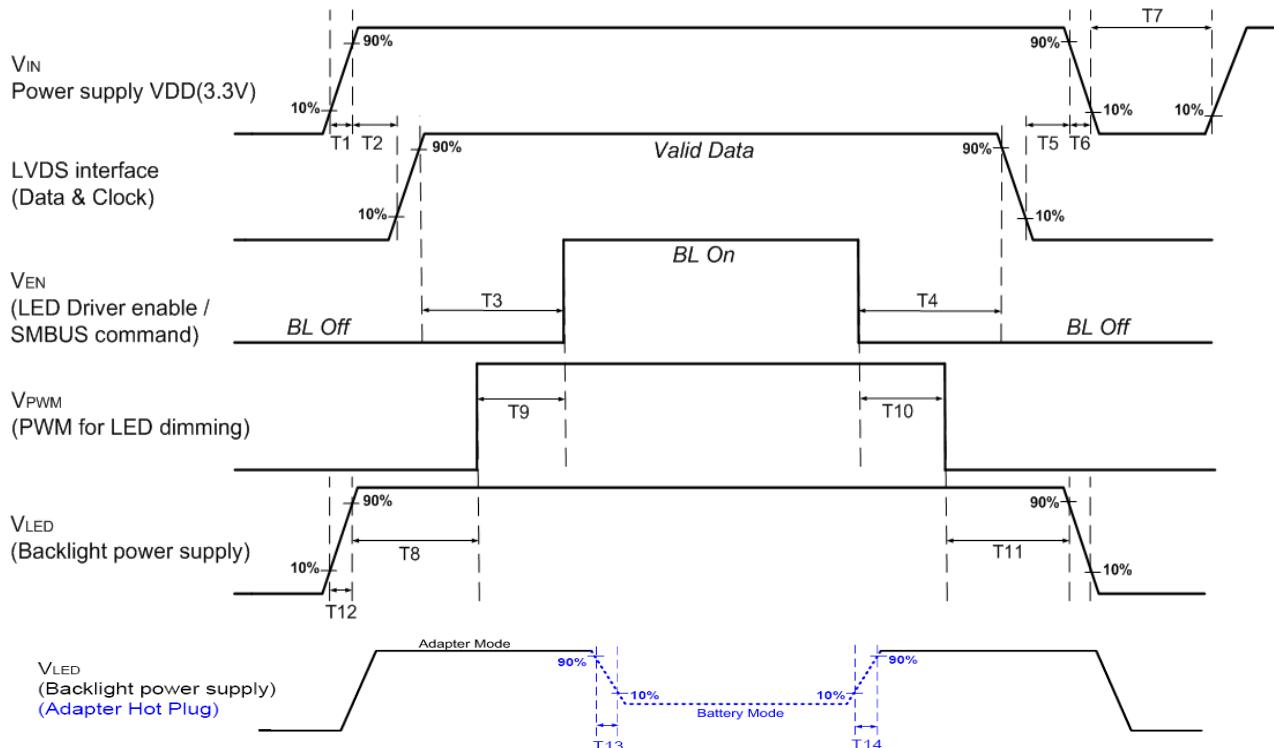
Parameter	Value	
	Min.(ms)	Max.(ms)
T1	0.5	10
T2	0	50
T3	200	-
T4	200	-
T5	0	50
T6	0	10
T7	500	-
T8	10	-
T9	10	-
T10	10	-
T11	10	-
T12	0.5	10
T13	1	-
T14	1	-

Note:If T3,T5,T6 couldn't match above specifications, must request T3+T5+T6 > 200ms at least

7. Panel Reliability Test

7.1 Vibration Test

Test Spec:

- Test method: Non-Operation
- Acceleration: 1.5 G
- Frequency: 10 - 500Hz Random
- Sweep: 30 Minutes each Axis (X, Y, Z)

7.2 Shock Test

Test Spec:

- Test method: Non-Operation
- Acceleration: 220 G , Half sine wave
- Active time: 2 ms
- Pulse: X,Y,Z .one time for each side

7.3 Reliability Test

Items	Required Condition	Note
Temperature Humidity Bias	Ta= 40℃, 90%RH, 300h	
High Temperature Operation	Ta= 50℃, Dry, 300h	
Low Temperature Operation	Ta= 0℃, 300h	
High Temperature Storage	Ta= 60℃, 35%RH, 300h	
Low Temperature Storage	Ta= -20℃, 50%RH, 250h	
Thermal Shock Test	Ta=-20℃to 60℃, Duration at 30 min, 100 cycles	
ESD	Contact : ±8 KV Air : ±15 KV	Note 1

Note1: According to EN 61000-4-2 , ESD class B: Some performance degradation allowed.

Self-recoverable.

No data lost, No hardware failures.

Remark: MTBF (Excluding the LED): 30,000 hours with a confidence level 90%

8. Mechanical Characteristics

8.1 LCM Outline Dimension

8.1.1 Standard Front View

The drawing following 2D standard drawing and remark.

NOTE
1. 15.6" wide LCD module mechanical outline dimension.
2. All dimension in mm.
As viewed form front of LCD modules.

8.1.2 Standard Rear View
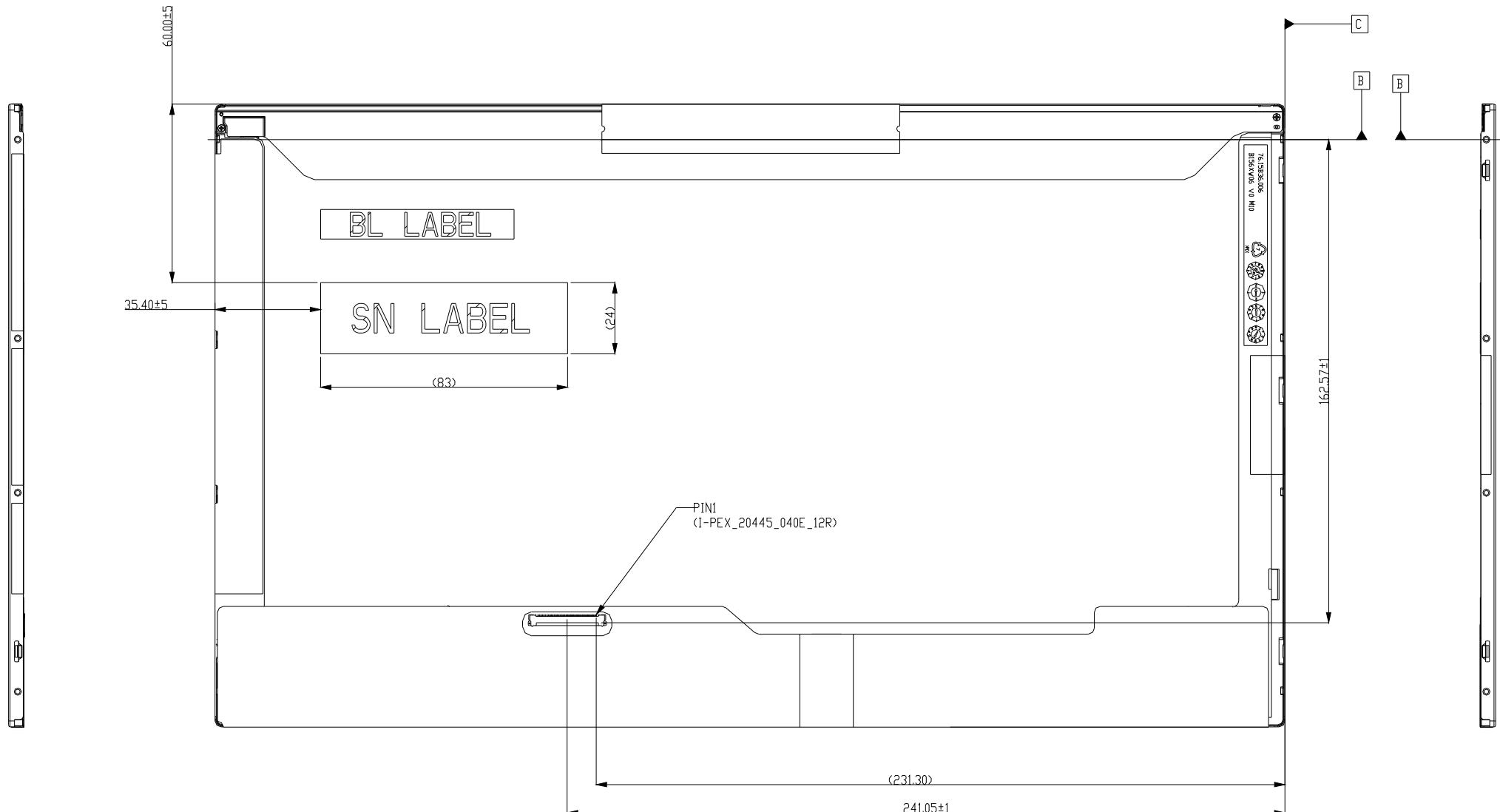
8.2 Screw Hole Depth and Center Position

Maximum Screw penetration from side surface is 2.3 mm

The center of screw hole center location is 3.7 ± 0.2mm from front surface

Screw Torque: Maximum 2.5 kgf-cm
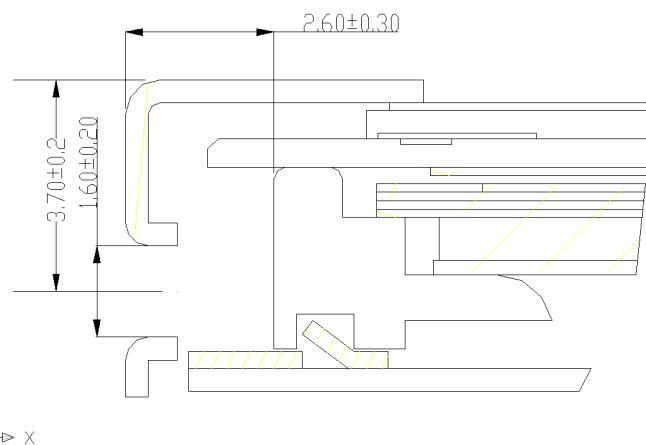
9. Shipping and Package

9.1 Shipping Label Format

Manufactured XX/XX
Model No: B156XTN02.1
AU Optronics
MADE IN China (S03)
H/W: 0A F/W:1

E204356

RoHS

B156XTN02.1

9.2 Carton Package

The outside dimension of carton is 437 (L)mm x 369 (W)mm x 313 (H)mm

Protect film B156XW01
V1 TORAY XY53
:77.15B34.003

Anti-Static Bag P/N: 79.15B01.001

通明膠帶貼附靜電帶開口處

83.15B34.001
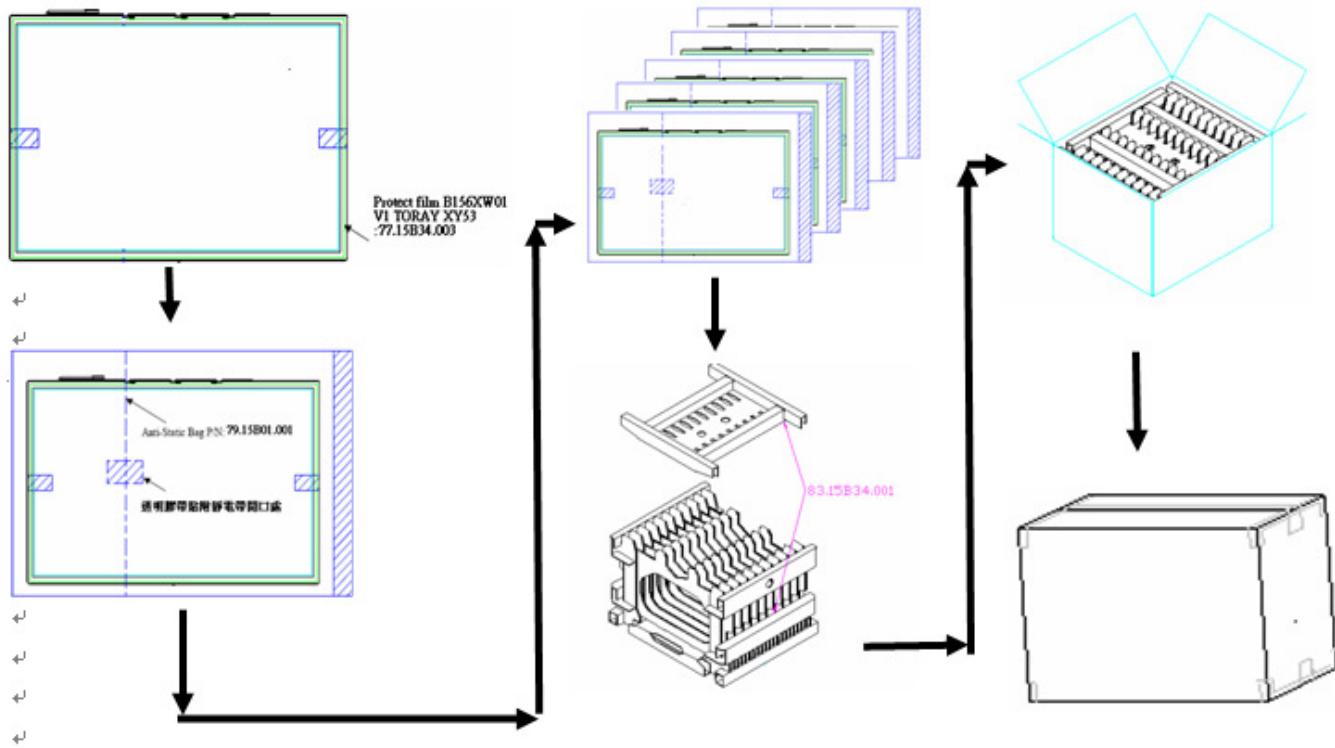
9.3 Shipping Package of Palletizing Sequence
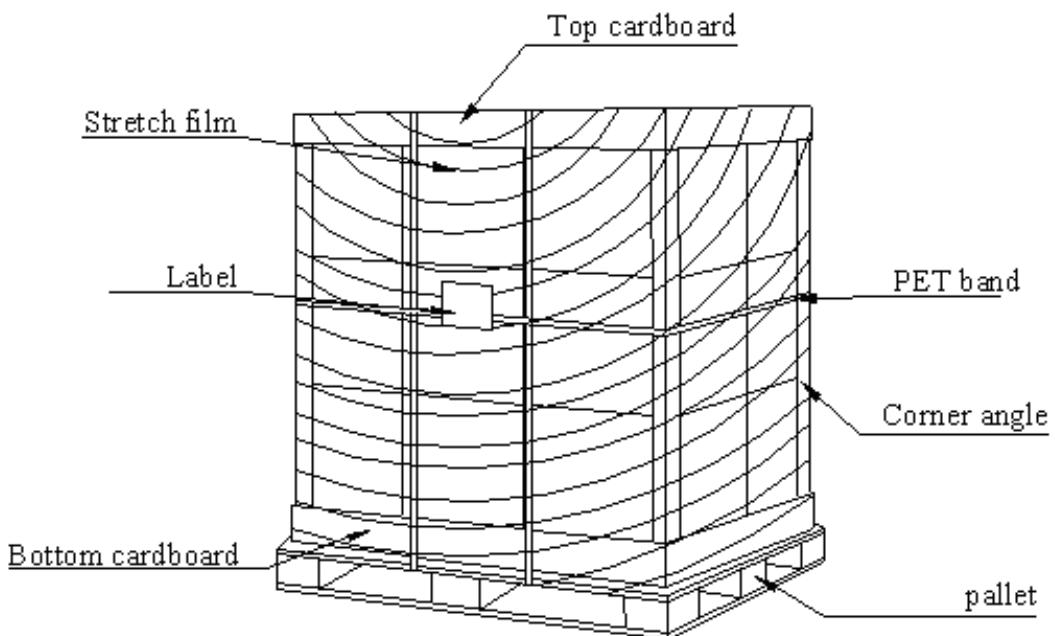
10. Appendix: EDID Description

TBD